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ABSTRACT

The effects of family background on adolescents' IQ, aptitude, and school achievement test scores challenge some of the usual beliefs about the fairness of achievement rather than IQ tests, and the role of genetic differences among individuals and social class groups in academic achievements. Subjects included 115 adoptive families with adolescent children, adopted in the first few months of life, and a comparison sample of 120 biological families with their own adolescent offspring. Families ranged from solid working to upper middle class. Regressions of adolescents' IQ, aptitude, and achievement test scores on measures of family background revealed that differences among social class environments have little effect on IQ scores but larger effects on school achievement scores. Working class adolescents are at a greater disadvantage relative to upper-middle class adolescents when the tests sample recently taught material. Genetic differences among individuals and among social class groups were found to be approximately the same for all types of tests. Correlations of related and unrelated siblings reared together suggest that the heritabilities of IQ and school test scores are in the range of .2 to .6 in a white population of working to upper-middle class families. (Author/BI)

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Heritability and Educational Policy: Genetic and Environmental Effects on IQ, Aptitude and Achievement

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ABSTRACT

Although there are no necessary policy implications from any research, this study of the effects of family background on adolescents' IQ, aptitude, and school achievement test scores challenges some of the usual beliefs about the fairness of achievement rather than IQ tests, and the role of genetic differences among individuals and social class groups in academic achievements. The study included 115 adoptive families with adolescent children, adopted in the first few months of life, and a comparison sample of 120 biological families with their own adolescent offspring. Both samples of families ranged from solid working to upper middle class.

Regressions of adolescents' IQ, aptitude, and achievement test scores on measures of family background revealed that differences among social class environments have little effect on IQ scores but larger effects on school achievement scores. Contrary to the beliefs of many school personnel, working class adolescents are at a greater disadvantage relative to upper-middle class adolescents when the tests sample recently taught material. Genetic differences among individuals and among social class groups were found to be approximately the same for all type of tests. Correlations of related and unrelated siblings reared together suggest that the heritabilities of IQ and school test scores are in the range of .2 to .6 in a white population of working to upper-middle class families.

Some implications of the social class bias in achievement tests and the consistent genetic differences in test scores are discussed.

Heritability and Educational Policy

Sandra Scarr

Yale University

I hope that you will agree with me from the outset that any proposed connection between genetic differences in intellectual achievements and educational policy is a tenuous and torturous path. In fact, I have argued (Scarr & Weinberg, 1978) that there are no necessary policy implications of any research on genetic differences in behavior, because policies are and should be more attuned to social values than to empirical data. But today I hope to explore with you our research on IQ, school aptitude, and school achievement tests, emphasizing the commonalities in their so-called heritabilities and the differences in the relationship of social background to each type of test. The punch line, for those of you who want to leave early, is that the closer a measure is to what is specifically and recently taught in the schools, the more that differences in adolescents' social environments accounts for differences in performance. Genetic differences, however, appear to be about equally implicated in all types of intellectual tests.

Further, I think that our research on adopted and biologically-related adolescents and their families has several implications for assessment practices in the schools and for educational policies toward the measurement of competency. If one believes that educational assessment should bear a close relationship to what is taught in the schools, then one would favor achievement over more general aptitude or IQ tests. If, on the other hand, one is more concerned with assessing intellectual achievements apart

from social class background, then, ironically, IQ tests are a fairer measure than school aptitude or achievement tests.

The Influence of "Family Background" on Intellectual Attainment

Family background has been much discussed and studied recently as a source of inequality among American adults (Behrman, Taubman, and Wales, 1978; Duncan, 1968; Duncan, Featherman, and Duncan, 1972, Grilliches and Mason, 1972; Jencks, 1972; Jencks and Brown, 1978; Sewell and Hauser, 1975; Taubman, 1976; Taubman and Wales, 1972, 1974). That accidents of birth leave us at the mercy of our families' fortunes, and that home environments can affect life chances, strike most social scientists as unfair, undemocratic, and even morally wrong. Even more difficult for some to accept is the idea that genetic differences among individuals and families can control some of our differences in adult achievements. The impact of family environmental and genetic differences on intellectual outcomes of children is the subject of this study.

It has been frequently reported in recent years that "family background" continues to affect intellectual, educational, occupational, and income differences long after children have grown up and left home. Some vaguely specified characteristics of the offspring are differentially rewarded by employers, and those offspring traits are correlated with parental and home characteristics, even 30 years after the offspring have left home. Although there are substantial differences among studies in the magnitude of the effects they find for family variables (Leibowitz, 1978; Crouse, 1978), there is no sign that the effects diminish with time; in fact, Taubman (1977) reported stronger effects of "family background" and own IQ as one approaches middle age.

Studies of outcome differences among the offspring of biologically-related families confound four sources of variance: within and between family, environmental and genetic differences. Regressions of individual outcomes on differences in family background are not illuminating as to the genetic or environmental sources of outcome differences, because parents transmit both genes and family environments that are likely to be correlated with each other and with genetic differences between families. In other words, the genetic variance in the predictors is likely to be correlated with the genetic variance in the outcomes.

Adopted children are not genetically descended from the family of rearing, so that environmental differences between families are not confounded with genetic differences in the children. Theoretically, regressions of adopted child outcomes on adoptive family characteristics will provide genetically unbiased estimates of true environmental effects in the population. Unfortunately, adoptive families are selected by agencies for being above average in many virtues, including socioeconomic status. Thus, they are always an unrepresentative sample of the population to which one would like to generalize. Therefore, it is important to have a comparison sample of biological families that are similarly selected.

The study reported in this paper includes both adoptive and biologically-related families. Regressions of intellectual measures of the children on the social background of their families will reveal the magnitude of environmental differences among the adoptive families, who share none of their genes. For biological families, the same regressions will yield estimates of the combined effects of shared family environments and about half

of the genetic variance. Differences between the regression equations of the adoptive and biological families are an estimate of the magnitude of genetic differences in measured family background as it is usually studied in sociological and psychological research on social class.

An additional focus of this research is sibling correlations for the measures of intellectual attainment. The intellectual correlation of unrelated children reared together as siblings is an estimate of the effect of environmental differences between families. It is the differences between families that cause similarities between children reared in the same home. The intellectual correlations of biological siblings are due, of course, to their shared family environments and to the half of their genes that they have in common. The difference, then, between the correlations of biological and adopted siblings is an estimate of the effect of having half of the same genes as ~~your~~ The sibling. From this difference between the adopted and biological sibling correlations, one can estimate the effect of genetic differences on intellectual scores in the population from which the children were sampled. This estimate is called heritability.

The children reported here are the oldest adoptive sample ever studied. The research was designed to assess the cumulative impact of family environments at the end of the child-rearing period. If differences in family environments have lasting impact on individual differences in intellectual functioning, the study of adolescents, adopted in the first few months of life, should reveal those differences.

Method

Subjects

The subjects in this report are members of 120 biological and 115

adoptive, white families in Minnesota. The adoptive families include 194 adopted and 15 biological children between the ages of 16 and 22. The biological families include 268 children in the same age range. Adoptive families were recruited through the Department of Public Welfare (DPW). The biological families were recruited through newspaper articles and advertisements, word of mouth, and the adoptive families. Full details of sample recruitment are given in Scarr & Weinberg (1978).

A crucial methodological consideration for any adoption study is the age at which the children are placed with their adopting families. Only early placements can guarantee that potentially confounding, early environmental experiences are minimized. All of the children in this study were in their homes before 12 months of age. The mean age of placement into the adoptive homes was 2.6 months. All adopted children are genetically unrelated to their adoptive parents and to each other. The biological children are all full siblings and claimed to be the biological offspring of both parents tested.

Procedure

Subjects in the sample were administered a 3-hour battery of tests and interviews at the University of Minnesota as part of a behavior genetic study of intellectual, personality, and attitudinal similarities within families. The data to be reported here are from the Wechsler Adult Intelligence Scale (WAIS, Wechsler, 1955). Four subtests of the WAIS were administered: vocabulary, arithmetic, block design, and picture arrangement. The combination of these four subtests has been shown to correlate above .90 with the full scale test score and is generally accepted as a shortened

version of the adult test (Doppelt, 1956). The test protocols were scored by an experienced psychometrician who was unaware of the respondents' adoptive status.

After scoring all of the tests, we became aware of a substantial sex difference on 3 of the 4 subtests, a fact seldom reported in the literature, but of which the Psychological Corporation seems to have been aware for some time (David Herman, personal communication). From the point of view of regression analysis, these mean sex differences are not critical, because there are about the same proportion of male and female children in the adoptive and biological samples (47 and 45 percent male, respectively).

Permissions from the parents and adolescents were obtained from every family to ask the secondary school where the adolescent was currently or recently enrolled for any test scores from the preceeding two years. Although all the schools responded to our request for test scores, some districts did not administer aptitude or achievement tests in the high schools, and some of the subjects had been out of high school too long to have current test scores. Thus, the school data are complete for all subjects within the limits of test administration and availability.

Because there was no state-wide assessment program in Minnesota in 1974-76, the school test scores reported in this paper are heterogeneous assortments of several tests. Some districts administered the Lorge-Thorndike, others the Otis-Lennon; in all there are 7 aptitude tests combined. Similarly, some districts gave the Stanford Achievement Tests, others the Iowa Tests of Educational Development; 7 achievement tests are combined for the achievement scores. We treated all of the aptitude and all of the achievement tests as parallel forms of the same tests.

Test scores were reported to us in national percentile form or in grade-equivalents that we translated into national percentiles with the appropriate test manual. For statistical purposes, the percentile scores were transformed into standard scores with a more normal distribution. Despite the threats to reliability from combining scores, across tests, our results will show that the usual correlations among IQ, aptitude, and achievement test scores were still obtained with this procedure, with the possible exception of numerical aptitude.

Results

Socioeconomic Variables

Table 1

The socioeconomic characteristics of the biologically-related and adoptive families are shown in Table 1. Parental educational levels in both kinds of families are .75 to 1 standard deviation above the averages of their cohorts in the population. The occupational prestige of the fathers, rated on the expanded NORC scale (Reiss, 1961) is about 60 in both types of families. Since less than half of the mothers were employed, their occupational ratings were not used in the analyses. Occupations of the fathers in the two samples varied from janitor, auto mechanic, small farmer (income less than $10,000), telephone installer, and sheet metal worker at the low end to physician, engineer, college professor, and radio station owner at the high end of the scale. Most occupations were in the middle range of carpenter and printer to insurance agent and building contractor.

Family income averaged $25,000 to $26,000 in both types of families. The income levels of the families may appear to be higher than they are, unless parental age is taken into account. In 1974, the median family income in the North Central region was $14,017, but the median family income

for families headed by workers ages 45-55 was approximately $18,000. The families in this sample are less than one standard deviation above that value.

The variance of the educational, occupational, and income measures is not as restricted as the high means might imply. In fact, the standard deviations are roughly comparable to the population figures (Taubman's veteran twin sample, personal communication, May 1977). Two points should be made, therefore, about the socioeconomic characteristics of these families: first, the adoptive and biological families are fairly comparable, and second, they both represent selected portions of the SES range in the U.S., both regionally and within the region from which they are drawn. It is well known that volunteers in social science research are self-selected for better-than-average characteristics of all kinds, and the sample of biological families is at least as biased in SES characteristics as the adoptive one. This is what we hoped would happen, without the statistically hazardous procedure of matching individual families.

Insert Table 1 about here

The adoptive and biological parents are also comparable in mean IQ scores and in the variance of their scores. Compared to the standardization sample for the WAIS (Wechsler Adult Intelligence Scale) the fathers are more than a standard deviation above the mean and the mothers about 3/4 of an S.D. above. It is not accidental, of course, that samples with above-average income, education, and occupational status also score above the average on a standard IQ test. The standard deviation of the parental IQ scores is only 3/4 of that of the population, a significant restriction. Their scores are significantly restricted in range, with the lowest score in the mid-90's.

The children of the two types of families are quite comparable in age, the mean being about 18 1/2 in both groups. The range of ages is 16 to 22 in both groups (with a few older or younger exceptions). There was no correlation between age and test scores.

The adopted children are not a genetically selected group. Their natural mothers averaged 12 years of education at a present average age of 41. The median educational level for women, aged 25-44 in the Minnesota area, is 12.5 years of education. Education is an indirect measure of intellectual ability, but as we have shown in another sutdy, there is good reason to expect that intellectual level of the natural mothers is reasonably well indexed by their educational levels (Scarr & Weinberg, 1976, 1977a, 1977b). Furthermore, there was a large study of unmarried mothers in the state of Minnesota during the years 1948-52, when IQ tests were mandated for all women giving up children for adoption. The average IQ score of 3,600 women was 100.00 with a standard deviation of 15.4 (Pearson & Amacher, 1956). Since our mothers were sampled from 1953-1959, there is no reason to expect them to differ significantly from the normal population. Fathers, of course, should not be expected to deviate from the average of the population any more than mothers. Thus, the adopted children are genetically a sample of an intellectually average population, while the biological children are more selected.

Correlations Among Parental Characteristics

The parental educational levels, family income, and father's occupation are similarly correlated in the biological and adoptive families. Despite the above-average means on all of these variables, the correlations are either greater or of the same magnitude as those reported from more repre-

sentative samples by Sewell and Hauser (1975), Jencks (1972), and others. These two facts -- the comparability of correlations in the two samples and their comparability with more representative samples -- encouraged us to proceed with the regression analyses.

Slide 2. Intellectual Achievements

The IQ scores of the adopted children are about 6 1/2 points lower than those of the biological children. These results are shown in Table 2. If IQ is heritable to any extent, one should expect the biological offspring of bright parents to have higher IQ scores than the offspring of an average sample. Both the biological and adoptive children score above the national average; in the case of adopted children the principle explanation for their 6 point advantage is their above average rearing environments. As a group they are living in socioeconomically advantaged homes with parents who chose to rear them. The biological offspring of similar families have both genetic and environmental advantages.

Consonant with the higher than average IQ scores are the above average school aptitude and achievement scores, reported in national percentile form. The biological offspring have higher average aptitude and achievement scores, as one would expect from their higher IQ scores.

Insert Tables 2 and 3 about here

Slide 3 Table 3 shows the intercorrelations of the IQ, aptitude, and achievement test scores. The individually-administered WAIS IQ scores correlate with the group administered aptitude test scores between .43 and .66 and with the school achievement scores in the same range, a moderately positive relationship. The school administered tests correlate slightly more with each other, particularly verbal aptitude and reading achievement. Overall,

it seems that the combination of 7 aptitude tests and 7 achievement tests created variables that lost some reliability, but this is not as much of a problem for the verbal aptitude or both achievement measures as for the numerical aptitude score, whose correlations with other measures are in the .50's and .60's, compared to the verbal measures whose correlations are in the .60's and .70's.

Correlations of Family Demographic Characteristics with Adolescents' Test Scores

Parental education, occupational status, and income represent important aspects of children's rearing environments, in that they index ways of life and family interaction. They are also correlated with neighborhood and school characteristics; as we all know, residential segregation by income and educational levels often guarantees that the children of the family attend schools and associate socially with children from similar families.

Insert Table 4 about here

For the parents, the demographic characteristics also represent individual achievements that are correlated with their own IQ scores; in these samples, educational level correlates .5 with IQ; occupational status and income correlate .4 with IQ. Since IQ is to some extent genetically transmitted, it is not surprising that the correlations of parental demographic characteristics with children's IQ, aptitude and achievement test scores are generally higher in biological than in adoptive families.

It is clear from Table 4 that parental education, family income, and parental IQ tend to be more highly correlated with the test scores of biological than adopted adolescents. Interestingly, father's occupational status does not show this pattern, for reasons I do not understand. It is

also noteworthy that fathers' characteristics are more highly related to adolescents' test scores than mothers' characteristics in both the biological and adoptive families. The paternal effect is particularly striking for school test scores. Because both parents are equally related genetically to the children, the greater paternal effect must be environmentally mediated. Fewer than half of the mothers in these samples are employed, so that they contribute little to family income, and the resulting choices of housing, neighborhood, and school. I think that fathers' characteristics are better indices of the social ecology of adolescents' neighborhood, schools and friendships, all of which impact school achievements more than they affect IQ. But more about that later.

Sibling order is clearly related to intellectual test scores in both the biological and adoptive samples. Later born and later adopted children are at a slight disadvantage in IQ, aptitude, and achievement test scores. Because the effect of sibling order is of similar magnitude in the two kinds of families, we can conclude that "birth order" is entirely a social effect.

Natural mother's characteristics correlate moderately with the adopted adolescents' test scores, even though they have had no contact with the children since birth. In fact, natural mother's education correlates more highly with the adopted adolescents' test scores than the adoptive parents' educational levels, even though the children have lived with these parents for the past 18 years. The obtained levels of correlations between adoptive parents and their children are, in fact, inflated slightly by the selective placement of the offspring of brighter natural mothers with more advantageous adoptive families. Selective placement for any partly heritable characteristic creates a small amount of shared genetic variance in adoptive families. Al-

though the calculations are too technical to describe here, we estimate that the correlation between natural mother's and adoptive parents' IQ scores is about .10, or high enough to create a genetically-based correlation between adoptive parents and adopted children's IQ scores of about .03.(Scarr & Weinberg, 1978). Given that natural mothers' educational level is as highly correlated with the adolescents' school test scores as with IQ scores, the same bias should exist in those adoptive family resemblances.

Regression Analyses

Each of the test scores was regressed first on family demographic characteristics, then on the demographics plus sibling order and parental IQ, and finally the adoptive adolescents' scores were regressed on the two sets of variables plus the natural mothers' age, education, and occupational status. The goal of these analyses was to estimate how much the indexed differences in family environments contribute to individual differences in IQ and school test scores. The contribution of genetic differences to test-score differences is grossly underestimated by this procedure, because the only parental scores available are WAIS IQ for the biological parents. The are no comparable data on the natural parents of the adopted children nor are there school test scores on any of the parents. Nonetheless, it is interesting to examine the pattern of R^2's obtained from the regression of the IQ, aptitude, and achievement scores on social and genetic background. Table 5 gives a summary of the regression analyses. (Detailed versions of the regressions are given in Tables 7-13.)

Insert Table 5 about here

Let us concentrate on the adoptive families first. Because the parents in this case provide only the social environment, it is possible to estimate

the effects of differences in these environments, which range socioeconomically from working to upper-middle class. The R^2 values, shrunken for each equation, give the estimated percentages of variance in test scores accounted for by socioeconomic differences between families -- that is, those social environmental features that siblings share — and by environmental differences between siblings within the same families, which are indexed here by sibling order (in biological families this would be called birth order).

Between Family Effects

The first striking result is that differences in adoptive families' income, parental education, fathers' occupations, and parents' IQ scores account for only one per cent of the variance in their adolescents' IQ scores. In fact, the uncorrected R^2 for the regression of adopted adolescents' IQ scores on their adoptive parents characteristics is only .02, which shrinks to .01 with correction. This means that differences between families' social class and intellectual environments have virtually no effect on IQ differences among their children at the end of the child rearing period.

For comparison, let us look at the same regression equation for the biological offspring of similar families, given at the bottom of Table 5. In contrast to .01, their R^2 is .26 for the same measures of between-family differences in social class and parental IQ. In the case of biological children, of course, these differences between families are due to both environmental and genetic differences, the latter being of overwhelming importance in explaining the IQ differences among adolescents in these families.

Within Family Effects

The within-family, environmental effects on IQ scores, indexed by sibling order, are 2 to 3 percent of the variance in both adoptive and biological families. Being earlier or later in the sibling order accounts for 0 to 5 per

cent of the test score variance among adopted children and 1 to 7 percent among the biological children, regardless of the kind of test — a modest but consistent effect.

As we move from IQ to school test scores, there are three important trends to notice: first, the effect of differences in social environments between families increases as the tests sample more recently taught material; second, natural mothers' genetic contribution to test score differences is similar and moderate across the various tests; and third, that the contribution of biological parents' IQ scores to their offsprings' test score differences is far less for aptitude and achievement tests than for IQ tests.

The first point, that social environmental differences are more important predictors of school test score differences than of IQ differences, is the core irony of this paper. The major difference in explained variance between IQ and school achievement test scores is that social class differences — that is, differences among families — account for the majority of the explained variability in achievement scores and virtually none of the IQ differences. It is the social environmental differences among the adoptive families, indexed by parental demographic characteristics, that contribute most to school achievement differences among the adopted adolescents. In one sense, then, school achievement tests are more biased against working class environments than are IQ tests!

Natural Mothers' Effects

To test the second point, the effects of genetic differences among the adopted adolescents, the index of genetic differences is admittedly very weak. We have information on only one of the natural parents, and that information is limited to educational and occupational level at the time of the child's birth and age, which was entered into the regression equations

to correct for any underestimation of younger mothers' educational and occupational levels. Regardless of the limitations of those variables, one can see from Table 6 that natural mothers' characteristics are substantially related to their offsprings' intellectual achievements, even though any variance due to selective placement has been removed by entering social environmental variables into the equations first.

As I noted early in this paper, the magnitude of the $\underline{R}^2$'s obtained from the adoptive sample is not an estimate of the true magnitude of environmental effects in the population, because these families have been selected by social agencies and represent a restricted sample of the general population. One can compare them, however, to the similarly selected biological families. Looking again at Table 5 we can see that the differences in total explained variance between the adopted and biological samples is very large for IQ scores (.20), smaller for aptitude scores (.08 to .15) and nil for achievement test scores (-.02 to -.04). Given the same indices of between and within family differences and some rough measures of biological parentage, the prediction equations are quite similar for achievement score differences in the adoptive and biological samples.

Biological Parents' IQ Effects

On the third point, the predictive power of biological parents' IQ scores, the detailed tables of regression analyses, available in the written version of the paper, show that parental IQ's decline from 15 percent of the variance in adolescent's IQ scores (holding everything else in the equation constant) to less than 2 percent of the variance in aptitude and achievement test scores (again holding constant education, income, and other variables). Parental IQ is by far the best predictor of IQ differences among biologically-related child-

ren, but parental education and family income are as good predictors of school aptitude score differences and better predictors of school achievement scores. This does not mean that the genetic differences are less important for aptitude and achievement scores, as we can note from both the natural mothers' data and from sibling correlations of test scores to be reported. But it does mean that parental IQ differences are more closely related to their offsprings' differences in IQ than in school achievements. If we had obtained reading and mathematics achievement scores for the parents, however, it may well be that the between family genetic differences would remain relatively constant across the kinds of tests while the impact of social environments would rise, giving a higher total between-family $\underline{R}^2$ for achievement than IQ test scores. From the adopted family results, it is clear that environmental differences among families are a trivial source of IQ differences and a substantial source of differences in school test scores.

Sibling Correlations

Another method for checking on the effects of family environment on test scores is to calculate the correlations between pairs of siblings who are genetically unrelated but who have been reared together from early infancy, as are our adopted children. Their sibling correlations are given in Table 6, with the corresponding biological sibling correlations for comparison.

Insert Table 6 about here

As one can see, there are negligible effects of being reared in the same household, neighborhood, and schools unless one is genetically related to one's brother or sister. The correlations of the biological siblings are modest but statistically different from zero.

With the most simple-minded version of the heritability coefficent and

an assumption that parental assortative mating is the same for aptitude and achievement as for IQ (for which we have parental assortative mating coefficients of about .25), we multiply the difference between the biological and adopted siblings' correlations by 1.6. The heritability estimates vary from .22 to .61, with a median of .37. Although these values are not .8, as some would claim, neither are they zero. More important for the present purposes, there seems to be no consistent difference in heritability by the kind of test.

The negligible differences in heritability for IQ, aptitude and achievement scores in this study of late adolescents is congruent with Lloyd Humphreys' findings of equal heritabilities for all cognitive measures in the Project Talent data (Humphreys, 1979) and the Texas Adoption Study result of equal sibling resemblances of IQ and school achievement measures in a sample of younger children (Willerman, Horn and Loehlin, 1977). In other words, there seems to be no greater sibling resemblance for one or another kind of intellectual achievement, when they are all "g" loaded. Humphreys and I agree, however, that some specific skills may have different heritabilities.

Discussion

Now, I want to qualify some of the shocking results I have imposed upon you today. First, let me describe again the limitations of the sample and the inferences one can make from the data. Then, let me describe the educational policy implications I would draw from the results. You are, of course, free to disagree with any of the policy statements I will make, because my values may differ from yours.

The most important qualification on the results of this study is that it does not apply to minority groups, to lower class, or abusive environments. Although the families sampled varied from solid working class to upper-middle class, there were no really deprived families among them. Thus, the study does not spaek to the performance of minority groups, to slum families, or to child abuse -- all of which I suspect have negative environmental impact on the kinds of test scores we obtained.

The second qualification is that explaining sources of variation within a sample does not speak to the average level of performance of the sample as a group. Even if differences in several demographic measures of family environments do not contribute much to differences in IQ aptitude, or achievement scores one must not conclude that the levels of environments in general make no difference for the development of intelligence. Obviously, the average performance level of the adopted children depends on the average value of their environments. In this sample, the average level of the environments is above average, and so is the average intellectual level of the unrelated children. Presumably, if they had been reared in below-average homes, the intellectual performance level of the group would also be below average.

The lack of systematic, measured, environmental differences among the adolescents suggests that within a range of "humane environments", from an SES level of working to upper-middle class, there is little evidence for differential environmental effects. The environments sampled in family studies are better than average at fostering intellectual development, but why are the relatively poor families rearing adopted children whose IQ scores are nearly as high as those in professional families? It must be

that all of these seeming environmental differences that predict so well to outcome differences among biological children are not primarily environmental differences, but indices of genetic differences among the parents and their biological offspring.

Implications for Educational Policy

There are two major findings of this study that I think raise issues for educational policy makers: first, the greater bias in school achievement than IQ tests against working class environments, and second, the substantial role that genetic differences play in the distribution of IQ, aptitude and achievement tests scores.

The finding of greater social class environmental bias in achievement than IQ tests seems to me to question the abandonment of IQ tests in favor of achievement measures. The major distinction between IQ and achievement tests is where and when one learns the material that is sampled on the tests. IQ tests sample more general cultural knowledge that is acquired incidentally in the course of living for some years in one's culture. Surely, there are specific vocabulary words and specific arithmetic skills on IQ tests, but most members of the culture have sufficient exposure to such material to give them opportunities to learn a great deal of information over their growing years. Furthermore, some people seek opportunities to learn new skills and information, while others do so less often. I am not arguing that IQ tests are culture-fair in any sense, but I am arguing that members of the majority culture, from working to upper-middle class, have ample opportunities for incidental learning of most material on the widely-used, individual IQ tests. What differs among people is the amount and complexity of the cultural information they have acquired, and of

course, how rapidly they can use that information to solve new problems.

Achievement tests on the other hand, are more closely tied to what schools teach and have taught in the recent past. These scores seem to be more biased by the differential exposure of people in the different social segments of the majority culture. As we all know, schools in suburban areas offer more advanced instruction than urban schools from the early grades on, because more of their students come from homes that supplement and amplify school learning. Although the working class child may be learning material that is relevant to IQ tests outside of school, his school achievement scores will be more closely tied to the specific instruction that he receives in the school and at home.

And so I see a dilemma in the political pressures toward more specific assessment of intellectual competencies -- from criterion referenced assessment to minimal competency exams.

The second finding, of substantial genetic differences in test scores, has two parts: (1) that individuals differ genetically in ways that affect how much they learn from similar exposures to material, and (2) that among whites in this culture, there seem to be average genetic differences in IQ and school test scores by social class. I suppose that most of us are prepared to accept the idea that individuals differ in part because of genetic differences. But more of us have difficulty accepting the idea that social class groups have on the average genetically-different levels of intellectual achievement, and that parental intellectual achievements, manifested in their social status, predict partially the intellectual levels and school achievements of their offspring because of genetic resemblance. Please remember that every population has a distribution of scores over the entire range, and that most of the variability

in scores is due to individuals within groups. The average differences between groups are a small portion of the total variability. Our data, however, support the conclusion that the greater part of that between-social class difference within the white population is due to average genetic differences among groups.

One policy issue that these results raise for me is whether every school building ought to be held to the same standard of school achievement as the New York State Regents propose to do. They will require a reading level of 9th grade for the award of a high school diploma and will put on probation those schools in which more than 15 percent of the students fail to meet the criterion. It seems to me from my data that the schools with working and lower class populations will suffer greater failure rates both because their students are on the average less able and because the tests they plan to use are more biased against incidental learning and toward material that requires school instruction. From one point of view, achievement tests sample what the schools ought to be teaching to everyone, but if the standards are set too high, many schools have been given an impossible test to meet for the sake of accountability.

Let me reiterate at the close that everyone will benefit from richer environments, and the average level of any group can be raised by more extensive and more intensive efforts to educate them. If we as a society decide that the effort and resources needed to bring 85 per cent of our adolescents to a reading level now typical of the 9th grade nationally, we may be able to do it. But the time and resources required to bring some individuals and some groups to that criterion will likely be far greater than the New York Regents imagine.

Some schools will have to spend all of their students' hours on preparing for the competency exam; others will have their students take it in the 10th grade with the reasonable expectation that 85 percent will pass, and that most of the remaining few will pass with a little additional help. Their school experiences will be far less rigidly tied to the competency exam. In the schools with high failure rates, the curriculum will be warped by the pressure to produce passing grades. Perhaps, we want school experiences to be noxious for many working and lower-class adolescents, but perhaps we don't. Or perhaps, the Regents and their middle class supporters really want to separate the sheep from the goats and to reinvest the High School diploma with an elitist value. Unless they are willing to invest extraordinary resources in schools with low achievement levels, I think we can hold them accountable for disinheriting educationally the predictably larger number of low SES adolescents who will fail.

Another implication of these results is that selection of able students for post-secondary education will be accomplished with less social class bias by general ability and IQ tests than by school achievement tests. This inference will no doubt please the conservatives and annoy the radicals, but that's the way I see it.

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Table 1: Family Demographic Summary Statistics (Per Child)

	Adolescents					
	Adopted			Biological		
	N	Mean	SD	N	Mean	SD
1. Father's Education	192	15.03	3.12	262	15.56	2.96
2. Mother's Education	201	14.03	2.07	262	14.51	2.28
3. Father's Occupation	195	60.68	23.69	266	62.01	24.52
4. Family Income (In Thousands)	207	25.94	10.20	266	24.98	8.77
5. Birth Rank	201	1.75	.82	265	2.19	1.09
6. Family Size	201	3.00	1.26	265	3.88	1.50
7. Father's IQ	193	116.88	10.94	266	117.45	11.88
8. Mother's IQ	202	113.61	10.23	266	113.13	10.66
9. Natural Mother's Age	184	22.28	1.73			
10. Natural Mother's Education	184	12.01	1.73			
11. Natural Mother's Occupation	162	31.77	23.43			

TABLE 2: Means and Standard Deviations of Test Scores for Biological and Adoptive Adolescents

	Biological			Adoptive		
	N	Mean	SD	N	Mean	SD
WAIS IQ	237	112.8	10.4	150	106.2	9.0
Total Aptitude* (Verbal & Numerical)	158	73.5	24.7	128	58.6	28.4
Total Achievement* (Reading & Math)	187	73.8	23.2	128	63.5	28.7

* National percentiles

Table 3: Intercorrelations of Test Scores

Adopted Adolescents

	IQ	VA	NA	TAp	RA	MA	TAc
WAIS IQ	X	.53	.43	.55	.60	.66	.71
Verbal Aptitude (VA)	.66	X	.53	(.87)	.78	.61	.80
Numerical Aptitude (NA)	.60	.63	X	(.88)	.50	.52	.59
Total Aptitude (TAp)	.72	(.89)	(.91)	X	.71	.64	.77
Reading Achievement (RA)	.49	.75	.51	.72	X	.63	(.90)
Math Achievement (MA)	.59	.66	.68	.76	.56	X	(.91)
Total Achievement (TAc)	.60	.78	.64	.82	(.88)	(.88)	X

Biological Adolescents

( ) = part-whole relationships

Table 4: Correlations of Family Demographic Variables and Parental IQ With Adolescents' IQ, Aptitude, and Achievement Scores

	Biological			Adoptive		
	IQ	Apt.	Ach.	IQ	Apt.	Ach.
Minimum N	237	158	185	150	128	128
Father's Education	.26	.35	.32	.10	.17	.18
Mother's Education	.24	.26	.21	.10	-.03	.04
Father's Occupation	.10	.25	.19	.12	.18	.28
Family Income	.22	.32	.34	.06	.01	-.03
Sibling Order	-.19	-.34	-.24	-.19	-.17	-.21
Father's IQ	.39	.35	.25	.15	.16	.22
Mother's IQ	.39	.17	.19	.04	.05	.05
Natural Mother's Education				.21	.24	.24
Natural Mother's Occupation (N=115)				.12	.18	.17
Natural Mother's Age				-.10	-.03	-.18

Table 5: R^2 Estimates of the Effects of Social Environmental and Genetic Differences on IQ, Aptitude, and Achievement Test Scores (Stepwise Regressions)

		Shrunken R^2's						
		WAIS	Aptitude			Achievement		
		IQ	Verbal	Num.	Total	Read	Math	Total
	Adopted Adolescents N =	150	147	128	128	140	128	128
Step								
	Social Environmental Indices							
1	Between Families[1]	.01	.05	.03	.04	.09	.08	.10
2	Within Families[2]	.02	.02	.00	.01	.01	.05	.03
	Total Environment	.03	.07	.03	.05	.10	.13	.13
3	Genetic Indices[3]	.06	.08	.02	.05	.07	.07	.09
	Total R^2	.09	.15	.05	.10	.17	.20	.22
	Biological Adolescents N =	237	231	158	158	195	187	187
	Social Environmental Indices and Genetic Indices							
1	Between Families[1]	.26	.19	.13	.18	.14	.14	.18
2	Within Families[2]	.03	.04	.04	.07	.01	.02	.02
	Total R^2	.29	.23	.17	.25	.15	.16	.20

Notes

1 = parental education, father's occupation, family income, parental WAIS IQ's

2 = sibling order

3 = natural mothers' education, occupation, and age (to correct for young mothers)

Table 6: Sibling Correlations of IQ, Aptitude, and Achievement Test Scores of Adopted and Biologically-Related Adolescents

	Biological		Adopted		
	N(pairs)	r	N(pairs)	r	$h^2 = 1.6(r_{bio} - r_{adopt})$
WAIS Verbal	168	.23	84	.07	.26
Performance	168	.21	84	.07	.22
IQ	168	.35	84	-.03	.61
Aptitude, Verbal	141	.29	68	.13	.26
Numerical	61	.32	49	.07	.40
Total	61	.32	49	.09	.37
Achievement, Reading	106	.27	73	.11	.26
Math	104	.35	58	-.11	.53
Total	104	.33	58	-.03	.58

Table 7: Standardized Regression Coefficients of WAIS IQ Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	237	150	237	150	150	132
Father's Education	.23*	.00	.07	-.05	-.08	-.03
Mother's Education	.12	.08	-.11	.09	.08	.07
Father's Occupation	-.15*	.11	-.14	.09	.09	.04
Family Income	.15	-.03	.09	-.02	-.10	-.10
Birth Rank			-.17*	-.20*	-.22*	-.25*
Father's IQ			.31*	.16	.15	.12
Mother's IQ			.36*	-.02	.00	-.02
Natural Mother's Age					-.15	-.07
Natural Mother's Education					.25*	.29*
Natural Mother's Occupation						.02
R^2	.11	.02	.31	.08	.14	.16
Shrunken R^2	.09	-.01	.29	.03	.08	.09

Table 8: Standardized Regression Coefficients of Verbal Aptitude Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	231	147	231	147	147	132
Father's Education	.33*	.04	.22*	-.04	-.08	-.05
Mother's Education	.06	.01	-.04	.02	.01	-.01
Father's Occupation	-.10	.20*	-.10	.16*	.14*	.13*
Family Income	.18*	-.03	.18*	-.03	-.04	-.02
Birth Rank			-.22*	-.21*	-.22*	-.20*
Father's IQ			.14*	.16*	.14*	.13*
Mother's IQ			.16*	.03	.02	.01
Natural Mother's Age					-.09	-.12*
Natural Mother's Education					.29*	.25*
Natural Mother's Occupation						.11*
R^2	.17	.05	.25	.10	.18	.19
Shrunken R^2	.16	.03	.23	.07	.14	.15

Table 9 : Standardized Regression Coefficients of Numerical Aptitude Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	158	128	158	128	128	115
Fahter's Education	.19*	.23*	.09	.20*	.18*	.23*
Mother's Education	-.01	-.19 *	-.04	-.15*	-.16*	-.20*
Father's Occupation	.03	.04	.02	.04	.03	.02
Family Income	.22*	-.06	.20*	-.08	-.08	-.05
Birth Rank			-.25*	-.06	-.06	-.04
Father's IQ			.12*	.08	-.06	.04
Mother's IQ			.03	-.08	-.09	-.10
Natural Mother's Age					-.05	-.09
Natural Mother's Education					.12*	.06
Natural Mother's Occupation						.18*
R^2	.12	.05	.19	.06	.07	.10
Shrunken R^2	.11	.03	.17	.03	.03	.05

Table 10: Standardized Regression Coefficients of Total Aptitude Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	158	128	158	128	128	115
Father's Education	.29*	.18*	.16*	.12	.09	.13
Mother's Education	.01	-.13*	-.05	-.11	-.12	-.15*
Father's Occupation	-.04	.13	-.04	.11	.09	.08
Family Income	.23*	-.07	.21*	-.07	-.08	-.05
Birth Rank			-.28*	-.16*	-.17*	-.15*
Father's IQ			.16*	.11	.10	.08
Mother's IQ			.09	.00	-.01	-.02
Natural Mother's Age					-.05	-.10
Natural Mother's Education					.22*	.17*
Natural Mother's Occupation						.16*
R^2	.17	.06	.27	.09	.13	.15
Shrunken R^2	.16	.04	.25	.05	.09	.10

Table 11: Standardized Regression Coefficients of Reading Achievement Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	195	140	195	140	140	124
Father's Education	.32*	.19*	.27*	.14*	.10	.12*
Mother's Education	-.08	-.05	-.13	-.04	-.04	-.06
Father's Occupation	-.08	.23	-.08	.21*	.21*	.21*
Family Income	.24*	-.19*	.24*	-.19*	-.20*	-.19*
Birth Rank			-.15*	-.11*	-.12*	-.11*
Father's IQ			.04	.11	.06	.06
Mother's IQ			.10	.00	.01	.00
Natural Mother's Age					-.21*	-.23*
Natural Mother's Education					.22*	.20*
Natural Mother's Occupation						.06
R^2	.14	.11	.18	.13	.21	.21
Shrunken R^2	.13	.09	.15	.10	.17	.17

Table 12: Standardized Regression Coefficients of Mathematics Achievement Sco on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	187	128	187	128	128	114
Father's Education	.22*	-.03	.16*	-.12	-.15	-.09
Mother's Education	-.01*	-.00	-.10	.08	.09	.04
Father's Occupation	-.08	.27*	-.08	.25*	.26*	.25*
Family Income	.27*	-.14*	.29*	-.17*	-.17*	-.14*
Birth Rank			-.19*	-.28*	-.29*	-.27*
Father's IQ			.04	.20*	.16*	.14*
Mother's IQ			.17*	-.11*	-.11	-.12*
Natural Mother's Age					-.19*	-.25*
Natural Mother's Education					.14*	.08
Natural Mother's Occupation						.21*
R^2	.13	.06	.19	.16	.21	.24
Shrunken R^2	.12	.04	.16	.13	.17	.20

Table 13 Standardized Regression Coefficients of Achievement Total Scores on Family Demographic Characteristics, Parental IQ, and Natural Parent Characteristics in Biologically-Related and Adoptive Families

	Bio	Adopt	Bio	Adopt	Adopt	Adopt
Minimum N	187	128	187	128	128	114
Father's Education	.30*	.09	.25*	.01	-.03	.00
Mother's Education	-.06	-.03	-.13*	.03	.03	.00
Father's Occupation	-.09	.28*	-.09	.25*	.25	.25*
Family Income	.30*	-.16*	.31*	-.18*	-.18*	-.16*
Birth Rank			-.18*	-.22*	-.24*	-.22*
Father's IQ			.03	.19*	.15*	.13*
Mother's IQ			.14*	-.07	-.07	-.08
Natural Mother's Age					-.21*	-.25*
Natural Mother's Education					.22*	.18*
Natural Mother's Occupation						.14*
R^2	.17	.10	.22	.16	.24	.26
Shrunken R^2	.16	.08	.20	.13	.20	.22